2.S: Chromosomes, Mitosis, and Meiosis (Summary)

- Chromosomes are complex and dynamic structures consisting of DNA and proteins (chromatin).
- The degree of chromatin compaction involves proteins and varies between heterochromatic and euchromatic regions and among stages of the cell cycle.
- Chromosomes can be distinguished cytologically based on their length, centromere position, and banding patterns when stained dyes or labeled with sequence-specific probes.
- Homologous chromosomes contain the same series of genes along their length, but not necessarily the same alleles. Sister chromatids initially contain the same alleles.
- Chromosomes are replicated by DNA polymerases and begin at an origin. Replication is bi-directional. Eukaryotes have multiple origins along each chromosome and have telomerase to replicate the ends.
- Mitosis reduces the c-number, but not the n-number. Meiosis reduces both c and n.
- Homologous chromosomes pair (synapase) with each other during meiosis, but not mitosis.
- Several types of structural defects in chromosomes occur naturally, and can affect cellular function and even evolution.
- Aneuploidy results from the addition or subtraction of one or more chromosomes from a group of homologs, and is usually deleterious to the cell.
- Polyploidy is the presence of more than two complete sets of chromosomes in a genome. Even-numbered multiple sets of chromosomes can be stably inherited in some species, especially plants.
- Endopolyploidy is tissue-specific type of polyploidy observed in some species, including diploids.
- Both aneuploidy and structural defects such as duplications can affect gene balance.
- Organelles also contain chromosomes, but these are much more like prokaryotic chromosomes than the nuclear chromosomes of eukaryotes.
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- **prophase**: Preparatory phase of mitosis.
- **metaphase**: Chromosomes align at the metaphase plate.
- **anaphase**: Chromosomes are separated and pulled to opposite poles.
- **telophase**: Chromosomes decondense to form replicated chromosomes.
- **DNA polymerase**: Enzyme that synthesizes DNA strands.
- **origin of replication**: The site where DNA replication begins.
- **telomerase**: Enzyme that synthesizes telomeres.
- **riboprotein**: Protein subunit of ribosome.
- **Hayflick limit**: The maximum number of times a human cell can divide in culture.
- **HeLa cells**: Human epithelial carcinoma cells.
- **cytokinesis**: The process of cell division.
- **S**: Synthesis phase of the cell cycle.
- **M**: Mitosis phase of the cell cycle.
- **G0**: Gap phase 0.
- **n**: Chromosome number.
- **c**: Chromosome count.
- **replicated chromosome**: Chromosome with two copies of DNA.
- **karyotype/karyogram**: Visual representation of chromosomes.
- **autosome**: Chromosome that is not a sex chromosome.
- **sex-chromosome**: Chromosome that determines sex.
- **homogametic**: Genetic condition where both chromosomes are identical.
- **chloroplast**: Cell organelle that contains chlorophyll.
- **mitochondria**: Cell organelle that generates energy.
- **endosymbiont**: Organism that lives inside another organism.
- **endosymbiont theory**: Hypothesis that mitochondria and chloroplasts evolved from ancient prokaryotes.
- **organellar chromosome**: Chromosome that is part of a chloroplast or mitochondrion.
- **mtDNA**: Mitochondrial DNA.